ABSTRACT OF THE DISCLOSURE

Apparatus for measuring a property of a fluid is provided including a tube for retaining the fluid, the tube including a lateral access opening and a domed portion including a sealing surface on the outside wall of the tube surrounding the lateral access opening and a sensor sealingly disposed on the sealing surface surrounding the lateral access opening in the tube for direct contact with the fluid in the tube for sensing the property of the fluid in the tube.

JC14 Rec'd PCT/PTO 26 NOV 2001

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DATE: November 26, 2001

FORM PTO 1390 (REV 11-2000) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		GAMBRO-258
		U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/980066
INTERNATIONAL APPLICATION NO. PCT/SE00/01132	INTERNATIONAL FILING DATES 30 May 2000	PRIORITY DATE CLAIMED 31 May 1999
TITLE OF INVENTION ARRANGEMENT FOR MEASURING A PROPERTY OF A FLUID PRESENT IN A TUBE		
APPLICANT(S) FOR DO/EO/US Johan Drott		

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [x] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing 35 U.S.C. 371
3. [x] This is an express request to begin national examination procedures (35 U.S.C. 371 (f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [x] The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. [x] A copy of the International Application as filed (35 U.S.C. 371 (c)(2))
   a. [ ] is attached hereto (required only if not communicated by the International Bureau).
   b. [x] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] An English language translation of the International Application as filed (35 U.S.C. 371 (c)(2)).
   a. [ ] is attached hereto.
   b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [x] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   b. [ ] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [x] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [x] An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)). (unexecuted)
10. [ ] An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. [x] An Information Disclosure Statement under 37 CFR 1.97 and 1.98. w/PTO-1449, 7 references
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [x] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [x] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. [x] A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. [ ] A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. [x] Other items or information: Substitute Abstract, Copy of International Preliminary Examination Report, Marked up Copy of Specification, Two (2) Sheets of Formal Drawings

U.S. APPLICATION NO (If known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/980066	PCT/SE00/01132	GAMBRO-258

21. [x] The following fees are submitted:

CALCULATIONS PTO USE ONLY

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) – (5)):

[x] Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO $1040.00

[ ] International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO $890 00

[ ] International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $740.00

[ ] International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) $710.00

[ ] International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =				$	1,040.00
Surcharge of $____ for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).				$	
CLAIMS	**NUMBER FILED**	**NUMBER EXTRA**	**RATE**		
Total claims	*14-20		x	$	0.00
Independent claims	2-3 =		x	$	0.00
MULTIPLE DEPENDENT CLAIM(s) (if applicable)			+	$	
TOTAL OF ABOVE CALCULATIONS =				$	1,040.00
[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.				$	
SUBTOTAL =				$	1,040.00
Processing fee of $____ for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				$	
TOTAL NATIONAL FEE =				$	1,040.00
Fee for recording the enclosed assignment (37 CFR 1.21 (h)). Assignment must be accompanied by appropriate cover sheet (37 CFR 3.28, 3.31) + (per property).				$	
TOTAL FEES ENCLOSED =				$	1,040.00
				Amount to be Refunded:	$
				Charged:	$

*As In Preliminary Amendment

a. [ ] A check in the amount of $____ to cover the above fees is enclosed.

b. [x] Please charge my Deposit Account No. 12-1095 in the amount of $ 1,040.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [x] The Commissioner is hereby authorized to charge any additional fees which may be required or credit any overpayment to my Deposit Account No. 12-1095. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO

LERNER, DAVID, LITTENBERG, KRUMHOLZ & MENTLIK, LLP

600 South Avenue West
Westfield, New Jersey 07090
(908) 518-6304

SIGNATURE:

Arnold H. Krumholz
NAME

25,428
REGISTRATION NUMBER

PATENT
GAMBRO 3.3-258

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of Johan DROTT	:	
	:	Group Art Unit:
International Application No. PCT/SE00/01132	:	Examiner:
International Filing Date: May 30, 2000	:	Date: November 26, 2001
For: ARRANGEMENT FOR MEASURING A PROPERTY OF A FLUID PRESENT IN A TUBE	:	

X

Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Preliminary to initiation of the prosecution of the above-identified pending U.S. patent application, the following amendments and remarks are respectfully submitted.

IN THE ABSTRACT

Please delete the Abstract as filed and substitute therefor the attached revised Abstract.

IN THE SPECIFICATION

Please amend the Specification in accordance with the attached revised Specification.

IN THE CLAIMS

Please cancel claims 1-13 and add new claims 14-27.

14. (NEW) Apparatus for measuring a property of a fluid comprising a tube for retaining said fluid, said tube including an outer wall, a lateral access opening, and a domed portion including a sealing surface on said outside wall of said tube surrounding said lateral access opening, and a sensor sealingly disposed on said sealing surface surrounding said lateral access opening in said tube for direct contact with said

fluid in said tube for sensing said property of said fluid in said tube.

15. (NEW) The apparatus of claim 14 wherein said sealing surface comprises a level surface.

16. (NEW) The apparatus of claim 14 wherein said domed portion of said tube comprises a bend in said entire tube.

17. (NEW) The apparatus of claim 14 wherein said domed portion of said tube comprises an outward bulge on one side of said tube.

18. (NEW) The apparatus of claim 14 wherein said sealing surface comprises the wall of said tube.

19. (NEW) The apparatus of claim 14 including adhering means for adhering said sensor to said sealing surface.

20. (NEW) The apparatus of claim 14 wherein said sensor comprises a sensor selected from the group consisting of a temperature sensor, a pressure sensor, a flow meter, and a conductivity sensor.

21. (NEW) The apparatus of claim 15 including a leveled-off planar portion of said wall of said tube on said outer side of said domed portion thereby providing said lateral access opening.

22. (NEW) The apparatus of claim 21 wherein said leveled-off planar portion of said wall comprises a ground-off portion thereof.

23. (NEW) The apparatus of claim 14 wherein said tube is elastic.

24. (NEW) The apparatus of claim 14 wherein said tube is flexible.

25. (NEW) The apparatus of claim 14 wherein said tube is rigid.

26. (NEW) The apparatus of claim 25 wherein said tube comprises a material selected from the group consisting of metal, plastic and glass.

27. (NEW) A dialysis monitor including apparatus for measuring a property of a fluid as set forth in claim 1.

REMARKS

The above-noted cancellation of claims 1-13, and addition of new claims 14-27, as well as the submission of a new Abstract and revisions to the Specification, are respectfully submitted prior to initiation of the prosecution of this application in the U.S. Patent and Trademark Office.

The above-noted new claims are respectfully submitted in order to more clearly and appropriately claim the subject matter which applicant considers to constitute his inventive contribution. No new matter is included in these amendments. In addition, the revisions to the Abstract and Specification are submitted in order to clarify and correct the Abstract and Specification and to conform them to all of the requirements of U.S. practice. No new matter is included in these amendments.

In view of the above, it is respectfully requested that these amendments now be entered, and that prosecution on the merits of this application now be initiated. If, however, for any reason the Examiner does not believe such action can be taken, it is respectfully requested that he telephone applicant's attorney at (908) 654-5000 in order to overcome any objections which he may have.

If there are any additional charges in connection with this requested amendment, the Examiner is authorized to charge applicant's Deposit Account No. 12-1095 therefor.

Respectfully submitted,

LERNER, DAVID, LITTENBERG,
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ARRANGEMENT FOR MEASURING A PROPERTY OF A FLUID PRESENT IN A TUBE

FIELD OF THE INVENTION

[0001] The present invention relates to apparatus for measuring a property of a fluid present in a tube, with a sensor for measuring the desired property, which sensor is disposed on the tube and is in direct contact with the fluid through a lateral access opening.

BACKGROUND OF THE INVENTION

[0002] Various implementations of apparatus for measuring a property of a fluid present in a tube are known. They are utilized in the most diverse apparatus, for example in dialysis monitors, for measuring any properties of the fluid. To this end, they generally comprise a sensor, which is suitable for measuring the desired property. The measured properties of the fluid are, for instance, the temperature, the flow velocity, the pressure, the conductivity, etc.

[0003] However, measuring these properties of the fluid requires the sensor to be in direct contact with the fluid, which is generally established through a lateral access opening, *i.e.* a lateral opening in the tube. For this, the sensor is arranged on the tube in such a way that it protrudes at least partially into the tube through the lateral access opening, and is thus in direct contact with the fluid which flows substantially completely around it. This is necessary for temperature sensors, for example, which must be substantially entirely surrounded by the fluid, or which have the fluid flow substantially entirely around them, in order to record an exact temperature.

[0004] The sensor may also be disposed on the tube such that it protrudes only into the lateral access opening, but not into the tube itself, so that it is in contact with the fluid, but the fluid does not flow completely around it, or is not entirely surrounded by fluid. This is adequate, for

example, for sensors with electrodes for measuring the inductance of the fluid.

[0005] However, owing to the geometry of the tube it is difficult to provide a lateral access opening that, on the one hand, allows for direct contact of the sensor with the fluid and, on the other hand, is reliably sealed from the surroundings. Apart from the requisite direct contact with the fluid, the sensor disposed on the tube also needs a connection to an evaluating unit or the like, in order to relay the measured values.

[0006] To resolve the sealing problems, German Patent Publication No. 35 08 570 suggests, for example, inserting a shut-off valve with a plug in a tube, the plug comprising a bore in the axis of rotation. A sensor is inserted in the bore and sealed with a sealing ring. Then, when for example as a result of the composition of the fluid, deposits build up with time on the sensor that is in direct contact with the fluid and impede the exact measurement of the required measured value, it is possible to replace the sensor without difficulty. To this end, the shut-off valve is set in its blocking position so that the fluid flow is interrupted and the sensor can be replaced without loss of fluid.

[0007] A disadvantage of this type of apparatus is that the tube must be completely severed during installation of the shut-off valve. Thus, after successful installation of the shut-off valve, additional seal surfaces with additional possible unsealed areas are created. Moreover, a shut-off valve entails an additional material expense in addition to the supplementary installation expense, thus creating additional costs.

[0008] An apparatus is known from German Patent Publication No. 41 01 549 for measuring temperatures in tubes, in which a bushing is welded laterally to a tube and forms a lateral access opening. A plug having a central bore is inserted in

the bushing. Furthermore, a temperature sensor is screwed into the bushing and is pushed through the bore of the plug to the fluid, and protrudes into the fluid. The plug, which seals the temperature sensor from the fluid, is specifically worked on the side directed towards the fluid. This is intended to prevent the formation of gaps between the plug and the tube wall as breeding grounds for bacteria and other germs.

[0009] While this makes possible a reliable seal of the temperature sensor from the fluid, this seal also requires a larger amount of labor. Specifically, lateral access to the tube must be provided, a bushing must be welded to the lateral access or the tube, respectively, and the plug specifically worked on the side directed towards the fluid, before the temperature sensor can be screwed into the bushing. This creates supplementary costs in addition to the required additional material.

[0010] An apparatus for measuring the temperature of a fluid present in a tube is known from European Patent No. 413,198, in which a bushing is similarly welded laterally to a tube and forms a lateral access opening to the fluid. An extensively worked ball valve is screwed into the bushing. A temperature sensor is pushed through the ball valve in the latter's open position up to the fluid in the tube, and is sealed against the fluid by ring seals before the ball valve and after the ball valve. In this way it is possible to replace the temperature sensor without shutting off the fluid. However, numerous seal surfaces are necessary, which increases the risk of leaks. In addition, this known apparatus is also expensive in terms of material and labor and is therefore costly.

[0011] In view of this background it is therefore an object of the present invention to provide apparatus for measuring a property of a fluid present in a tube, with a sensor for measuring the property, which sensor is arranged on the tube

and in direct contact with the fluid through a lateral access opening, that is simple and inexpensive to manufacture and in which the lateral access opening is reliably, simply and inexpensively sealed.

SUMMARY OF THE INVENTION

[0012] In accordance with the present invention, this and other objects have now been realized by the discovery of apparatus for measuring a property of a fluid comprising a tube for retaining the fluid, the tube including an outer wall, a lateral access opening, and a domed portion including a sealing surface on the outside wall of the tube surrounding the lateral access opening, and a sensor sealingly disposed on the sealing surface surrounding the lateral access opening in the tube for direct contact with the fluid in the tube for sensing the property of the fluid in the tube. Preferably, the sealing surface comprises a level surface.

[0013] In accordance with one embodiment of the apparatus of the present invention, the domed portion of the tube comprises a bend in the entire tube.

[0014] In accordance with another embodiment of the apparatus of the present invention, the domed portion of the tube comprises an outward bulge on one side of the tube.

[0015] In accordance with another embodiment of the apparatus of the present invention, the sealing surface comprises the wall of the tube.

[0016] In accordance with another embodiment of the apparatus of the present invention, the apparatus includes adhering means for adhering the sensor to the sealing surface.

[0017] In accordance with another embodiment of the apparatus of the present invention, the sensor is a temperature sensor, a pressure sensor, a flow meter, and/or a conductivity sensor. Preferably, the apparatus includes a leveled-off planar portion of the wall of the tube on the outer side of the domed portion thereby providing the lateral

access opening. In a preferred embodiment, the leveled-off planar portion of the wall comprises a ground-off portion thereof.

[0018] In accordance with one embodiment of the apparatus of the present invention, the tube is elastic, flexible, or rigid. Preferably, the rigid tube is made from metal, plastic and glass.

[0019] In accordance with another embodiment of the apparatus of the present invention, a dialysis monitor is provided including apparatus for measuring a property of a fluid as set forth above.

[0020] In accordance with the present invention, the above objects are achieved with apparatus of the type discussed above in which the tube includes a domed wall portion, the domed wall portion includes a seal surface on its outer side, the lateral access opening is formed in the seal surface, and the sensor is disposed in a sealed manner on the seal surface over the lateral access opening.

[0021] In this manner, a simple apparatus is provided, which for example may be used in dialysis monitors, which enables a simple and at the same time reliable seal of the lateral access opening on the tube. With the formation of the domed wall portion in the tube and the arrangement of a seal surface on the outer side of this domed wall portion, a large seal surface is provided that is formed substantially without edges and corners, on which the sensor can be simply disposed in a reliably sealed manner. The sensor is arranged over the lateral access opening, which is arranged in such a way in the seal surface, or which terminates in such a way in the seal surface, that it is surrounded by the seal surface. In this manner, on the one hand, the lateral access opening is simply and reliably sealed by the sensor itself and, on the other hand, the sensor is readily brought into direct contact with the fluid. The sensor thus sits on the seal surface and is

simultaneously in direct contact with the fluid.

[0022] By forming a domed wall portion and arranging a seal surface on the outer side thereof, there is in particular provided a larger seal surface that comprises no edges or corners and on which the sensor can sit. The apparatus known from the prior art having a lateral access opening in the tube generally include lateral seal surfaces having edges, corners or gaps. The sensor lies laterally against these seal surfaces, which renders a reliable seal difficult. This problem is removed by the present invention.

[0023] In particular when, in accordance with a preferred embodiment, the seal surface is a level surface, a further improved seal of the lateral access opening is made possible. A reliable seal can be obtained more easily on a level surface, and the sensor can simply be placed on the seal surface so that it covers the lateral access opening. When an appropriate seal is provided between sensor and seal surface, for example a sealing ring or even adhesion between sensor and seal surface, as provided in accordance with another preferred embodiment, the lateral access opening is then reliably sealed by the sensor itself.

[0024] The domed wall portion of the tube can be formed in any manner. For example, the whole tube can be bent to form the domed wall surface, as is provided according to a preferred embodiment. Similarly, the wall of the tube can be distended with a bulge on one side to form the domed wall portion, which is provided according to another preferred embodiment.

[0025] In both cases care should be taken that an adequately large domed wall portion is available to provide a sufficiently large seal surface on its outer side. Advantageously, in this case the wall of the tube forms the seal surface, which further facilitates the manufacture thereof.

[0026] The lateral access to the interior of the tube arranged in the seal surface can be formed in any manner. However, it is advantageous, and provided according to a preferred embodiment, when the lateral access opening is formed by levelling away the wall of the tube at the outer side of the domed wall portion along a flat plane. In doing this it is advantageous when the domed wall portion is ground away at its outer side to form the lateral access opening. In this manner, the seal surface will simultaneously be formed with the lateral access so that the manufacture is further simplified and the arrangement becomes altogether less expensive. Moreover, in this manner, a transition between the lateral access opening and the interior of the tube is provided that is favorable to flow, which is of particular advantage when the fluid present in the tube flows.

[0027] The lateral access opening can be formed in the manner described above both with an elastic and/or flexible tube, or also with a rigid tube. This apparatus is, however, particularly advantageous with a rigid tube, that for example can consist of metal, synthetic material or even glass. Particularly in the case of glass the sealing of a lateral access opening was previously difficult and coupled with problems, which are now removed by the present invention.

[0028] Any sensors can be used in the arrangement, such as for example temperature sensors, pressure sensors, flow meters or even conductivity sensors. Furthermore, the apparatus can be employed in diverse apparatus, such as in dialysis monitors.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The present invention will now be described in more detail with reference to the following detailed description, which, in turn, refers to the enclosed drawings, which depict preferred embodiments, as follows:

[0030] Fig. 1 is a side, elevational, partially sectional

view of one embodiment of the apparatus of the present invention;

[0031] Fig. 2 is a front, elevational, cross-sectional view, taken along line B-B in Fig. 1;

[0032] Fig. 3 is a side, elevational, partially sectional view of another embodiment of the apparatus of the present invention;

[0033] Fig. 4 is a front, elevational, cross-sectional view of yet another embodiment of the apparatus of the present invention;

[0034] Fig. 5 is a front, elevational, cross-sectional view of yet another embodiment of the apparatus of the present invention; and

[0035] Fig. 6 is a top, elevational view taken along line A-A in Fig. 1 and Fig. 3.

DETAILED DESCRIPTION

[0036] Referring to the drawings, in which like reference numerals refer to like elements thereof, Fig. 1 shows a first embodiment of the measurement apparatus 1 in longitudinal section. The measurement apparatus 1 includes a sensor 13 that is disposed on a tube 3 to measure properties of a fluid 17 present in the tube 3. The fluid 17 can be either stationary in the tube or flow through it.

[0037] The tube 3 comprises a domed wall portion 7 that, in this embodiment, is formed by bending the whole tube 3. On its outer side the domed wall portion 7 there is a seal surface 9, in which a lateral access opening 11 is arranged. In this embodiment, the seal surface 9 is formed together with the lateral access opening 11 by grinding away the outer side of the domed wall portion 7 along a flat plane. This plane is indicated by the dashed and dotted line A-A. The seal surface is thus formed by the ground away portion of the wall 5 of the tube 3. The form of the transition between the lateral access opening 11 and the interior of the tube 3 that is very

favorable in fluid mechanical terms can be readily seen here, and is particularly advantageous when the fluid flows.

[0038] The sensor 13 is arranged on the seal surface 9 in such a manner that it completely covers and thus seals the lateral access opening 11. Simultaneously, it is in direct contact with the fluid 17. The required seal between sensor 13 and seal surface 9 can be achieved in any desired manner. In the embodiment illustrated here, the sensor 13 is glued on the seal surface 9 by means of a suitable adhesive 19. However, it is also possible to provide, for example, a sealing ring or any other seal between the sensor 13 and the seal surface 9, whereby the sensor can then be attached to the tube 3 with any other suitable means.

[0039] The tube 3 in this case consists of glass but may consist of any other material such as plastic, metal or an elastic material.

[0040] In the first embodiment of the measurement apparatus 1 shown here the sensor 13 is in direct contact with the fluid 17 present in the tube 3 through the lateral access opening 11 of the tube 3. In this manner, the sensor 13 can directly determine or measure the desired property of the fluid 17 and relay the measured values by means of electrical connections 15 to an evaluation unit or the like, which is not illustrated, where they can then be processed.

[0041] In Fig. 2 is shown a section along line B-B of Fig. 1. As can be readily seen, the seal surface 9 is formed by the wall 5 of the tube 3 that has been levelled away along a flat plane on the outer side of the domed wall portion 7. As mentioned above, in this way the lateral access opening 11 to the interior of the tube 3 is formed at the same time as the seal surface 9, and a transition between the lateral access opening 11 and the interior of the tube 3 is obtained in a fluid-mechanically favorable fashion. The sensor 13 is arranged on the seal surface 9 above the lateral access

opening 11 in such a manner that it completely covers, and therefore seals, the lateral access opening 11.

[0042] In Fig. 3 is shown a second embodiment of the measurement apparatus in longitudinal section. Like parts are denoted by like reference numerals. The tube 3' of this embodiment is not bent as a whole to form the domed wall portion 7. Instead, only a region of the wall of the tube 3' bulges outwardly to form the domed wall portion 7.

[0043] Furthermore, in this case a seal surface 9 that is created by levelling away the outer side of the domed wall surface along a straight line A-A is formed on the outer side of the domed wall portion 7. As mentioned, in this manner the lateral access opening 11 is formed at the same time. The sensor 13 is then, in turn, arranged on the seal surface 9 such that it completely covers, and accordingly seals, the lateral access opening 11, while being simultaneously in direct contact with the fluid 17. A seal between sensor 13 and seal surface 9 is accomplished in this embodiment also by gluing the sensor 13 to the seal surface 9 by means of a suitable adhesive 19. The tube 3' is of metal, however the embodiment shown here can also be utilized with tubes of any other material, such as for example glass or plastic, or even elastic materials.

[0044] Here again the sensor 13 is coupled by electrical connections 15 to an evaluating unit (not shown), or the like, in order to relay and process the values determined by the sensor 13 regarding the property of the fluid 17 present in the tube 3'.

[0045] In the embodiment shown in Fig. 3 the cross-section of the tube 3' expands in the region of the apparatus, while the cross-section of the tube 3 of the first embodiment shown in Fig. 1 narrows in the region of the apparatus. Thus, the flow velocity of a fluid 17 flowing in the apparatus according to the first embodiment increases, while the flow velocity of

a fluid 17 flowing in the arrangement according to the second embodiment decreases. This can influence the property of the fluid 17 to be measured so that, depending on the property of the fluid 17 to be measured, the embodiment that does not, or least, influences the property to be measured is to be selected. Alternatively, however, it is also possible to form the domed wall portion 7 on the tube 3 or 3' such that no change, or only an extremely small and negligible change in cross-section of the tube 3 or 3', results.

[0046] An example of this is shown in Fig. 4, which shows a cross-section through the tube 3" in a similar fashion to Fig. 2. Like parts are denoted by like reference numerals. The tube 3" is rectangular and bent as a whole to form the domed portion 7 in a similar fashion to that shown in Fig. 1. The outer side of the domed portion 7 is completely levelled away up to the side walls to form the lateral access opening 11, such that the sensor 13 placed thereon takes the place of the original outer side. In this way, the original cross-section is retained.

[0047] A further example is shown in Fig. 5, which likewise shows a cross-section through a tube 3''' in a similar fashion to Fig. 2. Here again, like parts are denoted by like reference numerals. The tube 3''' comprises a circular cross-section and is bent as a whole to form the domed portion 7, in a similar fashion to that shown in Fig. 1. To form the lateral access opening 11, the outer side of the domed portion 7 is levelled away to just such an extent that a small opening is formed in the wall 5. This is covered by the sensor 13 placed thereon, the sensor 13 protruding only a little into the tube 3'''. This has the effect that the cross-section of the tube in the region of the measurement apparatus is only slightly, and on the whole negligibly, reduced.

[0048] Contrary to the previous embodiments, the sensor 13 is in this case attached to the seal surface 9 with a holding

band 23. The seal between sensor 13 and tube 3, or seal surface 9 respectively, is obtained with a sealing ring 21 in this embodiment.

[0049] Fig. 6 shows a plan view of a section along the line A-A in Fig. 1 and Fig. 3. It can be clearly seen here that the lateral access opening 11 is arranged in the seal surface 9 such that it is completely surrounded by the seal surface 9. This enables the simple, safe and reliable seal between the lateral access opening 11 and the sensor 13 (not shown), as described in detail above. The seal surface 9 is formed by the levelling away of wall 5 of the tube 3, 3' along a flat plane, which enables its simple and inexpensive formation. Moreover, in this manner, a level seal surface is provided that comprises no corners, edges or gaps and thus enables a simple and reliable seal.

[0050] Hence, an apparatus for measuring a property of a fluid present in a tube is provided that is simple and inexpensive to manufacture and simply and inexpensively enables a reliable sealing of the sensor utilized in the apparatus. The apparatus can be employed for any application and for any apparatus, for example also in dialysis monitors. In the latter, the apparatus could, for example, be equipped with a conductivity sensor to determine the conductivity of the dialysis fluid. However, this does not limit the apparatus to this purpose.

[0051] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

ARRANGEMENT FOR MEASURING A PROPERTY OF A FLUID PRESENT IN A TUBE

The present invention concerns an arrangement for measuring a property of a fluid present in a tube, with a sensor for measuring the desired property, which sensor is disposed on the tube and is in direct contact with the fluid through a lateral access.

TECHNICAL BACKGROUND

Various implementations of arrangements for measuring a property of a fluid present in a tube are known. They are utilised in the most diverse apparatus, for example also in dialysis monitors, for measuring any properties of the fluid. To this end, they generally comprise a sensor, which is suitable for measuring the desired property. The measured properties of the fluid are, for instance, the temperature, the flow velocity, the pressure, the conductivity, etc.

However, measuring these properties of the fluid requires the sensor to be in direct contact with the fluid, which generally is established through a lateral access, i.e. a lateral opening in the tube. For this, the sensor is arranged on the tube in such a way that it protrudes at least partially into the tube through the lateral access and thus is in direct contact with the fluid which flows substantially completely around it. This is necessary for temperature sensors, for example, which must be substantially entirely surrounded by the fluid, or which have the fluid flow substantially entirely around them, in order to record an exact temperature.

The sensor may also be disposed on the tube such that it protrudes only into the lateral access, but not into the tube itself, so that it is in contact with

the fluid, but the fluid does not flow completely around it or is, respectively, not entirely surrounded by fluid. This is adequate for example for sensors with electrodes for measuring the inductance of the fluid.

However, owing to the geometry of the tube it is difficult to provide a lateral access that, on the one hand, allows the direct contact of the sensor with the fluid and, on the other hand, is reliably sealed from the surroundings. Apart from the requisite direct contact with the fluid, the sensor disposed on the tube also needs a connection to an evaluating unit or the like, in order to relay the measured values to this.

To resolve the sealing problems, DE 35 08 570 suggests for example inserting a shut-off valve with plug in a tube, wherein the plug comprises a bore in the axis of rotation. A sensor is inserted in the bore and sealed with a sealing ring. Then, when for example as a result of the composition of the fluid, deposits build up with time on the sensor that is in direct contact with the fluid and impede the exact measurement of the required measured value, it is possible to replace the sensor without problems. To this end, the shut-off valve is set in its blocking position so that the fluid flow is interrupted and the sensor can be replaced without loss of fluid.

A disadvantage of this is that the tube must be completely severed during the installation of the shut-off valve. Thus after successful installation of the shut-off valve, additional seal surfaces with additional possible unsealed areas are created. Moreover, a shut-off valve entails an additional material expense in addition to the supplementary installation expense and thus causes additional costs.

An apparatus is known from DE 41 01 549 for measuring temperatures in tubes, wherein a bushing is welded laterally to a tube and forms a lateral access. A plug having a central bore is inserted in the bushing. Furthermore, a temperature sensor is screwed into the bushing and is pushed through the bore of the plug to the fluid and protrudes into the fluid. The plug, which seals the

temperature sensor from the fluid, is specially worked on the side directed towards the fluid. This is intended to prevent the formation of gaps between plug and tube wall as breeding grounds for bacteria and other germs.

While this makes possible a reliable seal of the temperature sensor from the fluid, this seal however requires a larger amount of labour. Specifically, a lateral access to the tube must be provided, a bushing must be welded to the lateral access or the tube respectively, and the plug specially worked on the side directed towards the fluid, before the temperature sensor can be screwed into the bushing. This causes supplementary costs in addition to the additionally required material.

An arrangement for measuring the temperature of a fluid present in a tube is known from EP 413 198, wherein a bushing is similarly welded laterally to a tube and forms a lateral access to the fluid. An extensively worked ball valve is screwed into the bushing. A temperature sensor is pushed through the ball valve in the latter's open position up to the fluid in the tube, and is sealed against the fluid by ring seals before the ball valve and after the ball valve. In this way it is possible to replace the temperature sensor without shutting off the fluid. However, numerous seal surfaces are necessary, which increases the risk of leaks. In addition, this known arrangement is also expensive in terms of material and labour and is therefore costly.

SUMMARY OF THE INVENTION

In view of this background it is therefore an object of the present invention to provide an arrangement for measuring a property of a fluid present in a tube, with a sensor for measuring the property, which sensor is arranged on the tube and in direct contact with the fluid through a lateral access, that is simple and inexpensive to manufacture and in which the lateral access is reliably, simply and inexpensively sealed.

This object is achieved with an arrangement of the described type,

wherein the tube includes a domed wall portion, the domed wall portion includes a seal surface on its outer side, the lateral access is formed in the seal surface, and the sensor is disposed in a sealed manner on the seal surface over the lateral access

In this way a simple arrangement is provided, which for example may be used in dialysis monitors and enables a simple and at the same time reliable seal of the lateral access on the tube. With the formation of the domed wall portion in the tube and the arrangement of a seal surface on the outer side of this domed wall portion, a large seal surface is provided that is formed substantially without edges and corners, on which the sensor can be simply disposed in a reliably sealed manner. The sensor is arranged over the lateral access, which is arranged in such a way in the seal surface, or which, respectively, terminates in such a way in the seal surface, that it is surrounded by the seal surface. In this manner, on the one hand, the lateral access is simply and reliably sealed by the sensor itself and, on the other hand, the sensor is brought easily into direct contact with the fluid. The sensor thus sits on the seal surface and is simultaneously in direct contact with the fluid.

By forming a domed wall portion and arranging a seal surface on the outer side of the same, there is in particular provided a larger seal surface that comprises no edges or corners and on which the sensor can sit. The arrangements known from the prior art having a lateral access in the tube generally include lateral seal surfaces having edges, corners or gaps. The sensor lies laterally against these seal surfaces, which renders a reliable seal difficult. This problem is removed by the present invention.

In particular when, in accordance with a preferred embodiment, the seal surface is a level surface, a further improved seal of the lateral access is made possible. A reliable seal can be obtained more easily on a level surface, and the sensor can simply be placed on the seal surface so that it covers the lateral access. When an appropriate seal is provided between sensor and seal surface,

for example a sealing ring or even adhesion between sensor and seal surface, as provided in accordance with another preferred embodiment, the lateral access is then reliably sealed by the sensor itself.

The domed wall portion of the tube can be formed in any manner. For example, the whole tube can be bent to form the domed wall surface, as is provided according to a preferred embodiment. Similarly, the wall of the tube can be distended with a bulge on one side to form the domed wall portion, which is provided according to another preferred embodiment.

In both cases care should be taken that an adequately large domed wall portion is available to provide an adequately large seal surface on its outer side. Advantageously, in this case the wall of the tube forms the seal surface, which facilitates the manufacture further.

The lateral access to the interior of the tube arranged in the seal surface can be formed in any manner. However, it is advantageous, and provided according to a preferred embodiment, when the lateral access is formed by levelling away the wall of the tube at the outer side of the domed wall portion along a flat plane. In doing this it is advantageous when the domed wall portion is ground away at its outer side to form the lateral access. In this way the seal surface will simultaneously be formed with the lateral access so that the manufacture is still further simplified and the arrangement becomes altogether less expensive. Moreover, in this way a transition between the lateral access and the interior of the tube is provided that is favourable to flow, which is of particular advantage when the fluid present in the tube flows.

The lateral access can be formed in the described way both with an elastic and/or flexible tube, or also with a rigid tube. This arrangement is, however, particularly advantageous with a rigid tube, that for example can consist of metal, synthetic material or even glass. Particularly in the case of this last material the sealing of a lateral access was previously difficult and coupled with problems, which are now removed by the present invention.

Any sensors can be used in the arrangement, such as for example temperature sensors, pressure sensors, flow meters or even conductivity sensors. Furthermore the arrangement can be employed in diverse apparatus, such as in dialysis monitors.

DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail with reference to the enclosed drawings, which depict preferred embodiments. These show in

Fig. 1 a longitudinal section through a first embodiment;

Fig. 2 a cross-section along the line B-B in Fig. 1;

Fig. 3 a longitudinal section through a second embodiment;

Fig. 4 a cross-section through a third embodiment;

Fig. 5 a cross-section through a fourth embodiment; and

Fig. 6 a section along the line A-A in Fig. 1 and Fig. 3.

DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 shows a first embodiment of the measurement arrangement 1 in longitudinal section. The measurement arrangement 1 includes a sensor 13 that is disposed on a tube 3 to measure properties of a fluid 17 present in the tube 3. The fluid 17 can be either stationary in the tube or flow through it.

The tube 3 comprises a domed wall portion 7 that in this embodiment is formed by bending the whole tube 3. On its outer side the domed wall portion 7 has a seal surface 9, in which a lateral access 11 is arranged. In this embodiment, the seal surface 9 is formed together with the lateral access 11 by grinding away the outer side of the domed wall portion 7 along a flat plane. This plane is indicated by the dashed and dotted line A-A. The seal surface is thus formed by the ground away portion of the wall 5 of the tube 3. The form

of the transition between the lateral access 11 and the interior of the tube 3 that is very favourable in fluid mechanical terms can be readily seen here, and is particularly advantageous when the fluid flows.

The sensor 13 is arranged on the seal surface 9 in such a manner that it completely covers and thus seals the lateral access 11. Simultaneously it is in direct contact with the fluid 17. The required seal between sensor 13 and seal surface 9 can be achieved in any desired manner. In the embodiment illustrated here, the sensor 13 is glued on the seal surface 9 by means of a suitable adhesive 19. However, it is also possible to provide, for example, a sealing ring or any other seal between the sensor 13 and the seal surface 9, whereby the sensor can then be attached to the tube 3 with any other suitable means.

The tube 3 consists here of glass but may consist of any other material such as plastic, metal or of an elastic material.

In the first embodiment of the measurement arrangement 1 shown here the sensor 13 is in direct contact with the fluid 17 present in the tube 3 through the lateral access 11 of the tube 3. In this way, the sensor 13 can directly determine or measure the desired property of the fluid 17 and relay the measured values by means of the electrical connections 15 to an evaluation unit or the like, which is not illustrated, where they can then be processed.

In Fig. 2 is shown a section along the line B-B of Fig. 1. As can be readily seen, the seal surface 9 is formed by the wall 5 of the tube 3 that has been levelled away along a flat plane on the outer side of the domed wall portion 7. As mentioned above, in this way the lateral access 11 to the interior of the tube 3 is formed at the same time as the seal surface 9, and a transition between the lateral access 11 and the interior of the tube 3 is obtained in a fluid-mechanically favourable fashion. The sensor 13 is arranged on the seal surface 9 above the lateral access 11 in such a manner that it completely covers, and therefore seals, the lateral access 11.

In Fig. 3 is shown a second embodiment of the measurement

arrangement in longitudinal section. Like parts are denoted by like reference numerals. The tube 3' of this embodiment is not bent as a whole to form the domed wall portion 7. Instead, only a region of the wall of the tube 3' bulges outwardly to form the domed wall portion 7.

Furthermore, here also a seal surface 9 that is created by levelling away the outer side of the domed wall surface along a straight line A-A is formed on the outer side of the domed wall portion 7. As mentioned, in this way the lateral access 11 is formed at the same time. The sensor 13 is then, in turn, arranged on the seal surface 9 such that it completely covers, and accordingly seals, the lateral access 11, while being simultaneously in direct contact with the fluid 17. A seal between sensor 13 and seal surface 9 is accomplished in this embodiment also by gluing the sensor 13 to the seal surface 9 by means of a suitable adhesive 19. The tube 3' is of metal, however the embodiment shown here can also be utilised with tubes of any other material, such as for example glass or plastic, or even elastic materials.

Here again the sensor 13 is coupled by electrical connections 15 to a non-depicted evaluating unit or the like, in order to relay and process the values determined by the sensor 13 regarding the property of the fluid 17 present in the tube 3'.

In the embodiment shown in Fig. 3 the cross-section of the tube 3' expands in the region of the arrangement, while the cross-section of the tube 3 of the first embodiment shown in Fig. 1 narrows in the region of the arrangement. Thus, the flow velocity of a fluid 17 flowing in the arrangement according to the first embodiment increases, while the flow velocity of a fluid 17 flowing in the arrangement according to the second embodiment decreases. This can influence the property of the fluid 17 to be measured so that, depending on the property of the fluid 17 to be measured, the embodiment that does not, or least, influences the property to be measured is to be selected. Alternatively, however, it is also possible to form the domed wall portion 7 on

the tube 3 or 3' such that no or only an extremely small and negligible change in cross-section of the tube 3 or 3' results.

An example of this is shown in Fig. 4 that shows a cross-section through the tube 3'' in a similar fashion to Fig. 2. Like parts are denoted by like reference numerals. The tube 3'' is rectangular and bent as a whole to form the domed portion 7 in a similar fashion to that shown in Fig. 1. The outer side of the domed portion 7 is completely levelled away up to the side walls to form the lateral access 11, such that the sensor 13 placed thereon takes the place of the original outer side. In this way, the original cross-section is retained.

A further example is shown in Fig. 5, which likewise shows a cross-section through a tube 3''' in a similar fashion to Fig. 2. Here again like parts are denoted by like reference numerals. The tube 3''' comprises a circular cross-section and is bent as a whole to form the domed portion 7, in a similar fashion to that shown in Fig. 1. To form the lateral access 11, the outer side of the domed portion 7 is levelled away to just such an extent that a small opening is formed in the wall 5. This is covered by the sensor 13 placed thereon, the sensor 13 protruding only a little into the tube 3'''. This has the effect that the cross-section of the tube in the region of the measurement arrangement is only slightly, and on the whole negligibly, reduced.

Contrary to the previous embodiments, the sensor 13 is here attached to the seal surface 9 with a holding band 23. The seal between sensor 13 and tube 3, or seal surface 9 respectively, is obtained with a sealing ring 21 in this embodiment.

Fig. 6 shows a plan view of a section along the line A-A in Fig. 1 and Fig. 3. It can be clearly distinguished here that the lateral access 11 is arranged in the seal surface 9 such that it is completely surrounded by the seal surface 9. This enables the simple, safe and reliable seal between the lateral access 11 and the sensor 13, which is not shown here, as described in detail above. The

seal surface 9 is formed by the levelling away of wall 5 of the tube 3, 3' along a flat plane, which enables its simple and inexpensive formation. Moreover, in this way a level seal surface is provided that comprises no corners, edges or gaps and thus enables a simple and reliable seal.

Hence all in all an arrangement for measuring a property of a fluid present in a tube is provided that is simple and inexpensive to manufacture and simply and inexpensively enables a reliable sealing of the sensor utilised in the arrangement. The arrangement can be employed for any application and for any apparatus, for example also in dialysis monitors. In the latter, the arrangement could for example be equipped with a conductivity sensor to determine the conductivity of the dialysis fluid. However, this does not limit the arrangement to this purpose.

LIST OF REFERENCE NUMERALS

1	Measuring arrangement
3	Tube
5	Wall
7	Domed wall portion
9	Seal surface
11	Lateral access
13	Sensor
15	Electrical connection
17	Fluid
19	Adhesive
21	Sealing ring
23	Holding band

CLAIMS

1. Arrangement for measuring a property of a fluid (17) present in a tube (3),
with a sensor (13) for measuring the property, which sensor (13) is disposed on the tube (3) and is in direct contact with the fluid (17) through a lateral access (11),
characterised in that the tube (3) comprises a domed wall portion (7),
the domed wall portion (7) has a seal surface (9) on its outer side,
the lateral access (11) is arranged in the seal surface (9),
and the sensor (13) is arranged in a sealed manner on the seal surface (9) over the lateral access (11).

2. Arrangement according to claim 1, **characterised in that** the seal surface (9) is a level surface.

3. Arrangement according to claim 1 or 2, **characterised in that** the whole tube (3) is bent to form the domed wall portion (7).

4. Arrangement according to claim 1 or 2, **characterised in that** the wall (5) of the tube (3) is bulged outwardly on one side of the tube (3) to form the domed wall portion (7).

5. Arrangement according to any one of the previous claims, **characterised in that** the wall (5) of the tube (3) forms the seal surface.

6. Arrangement according to any one of the previous claims, **characterised in that** the sensor (13) is adhered on to the seal surface (9).

7. Arrangement according to any one of the previous claims, **characterised in that** the sensor is a temperature sensor, a pressure sensor, a flow meter or a conductivity sensor (13).

8. Arrangement according to any one of claims 2 to 7, **characterised in that** the lateral access (11) is formed by levelling away of the wall (5) of the tube (3) on the outer side of the domed wall portion (7) along a flat plane.

9. Arrangement according to claim 8, **characterised in that** the lateral access (11) is formed by grinding.

10. Arrangement according to any one of the previous claims, **characterised in that** the tube (3) is elastic and/or flexible.

11. Arrangement according to any one of claims 1 to 9, **characterised in that** the tube (3) is rigid.

12. Arrangement according to claim 11, **characterised in that** the tube (3) is of metal, plastics or glass.

13. Dialysis monitor with an arrangement according to any one of the previous claims.

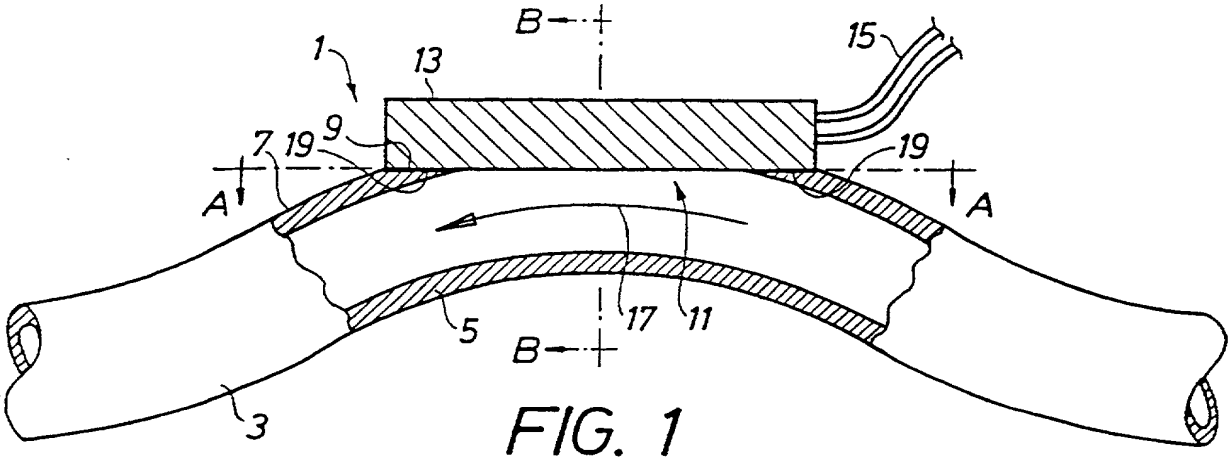

FIG. 1

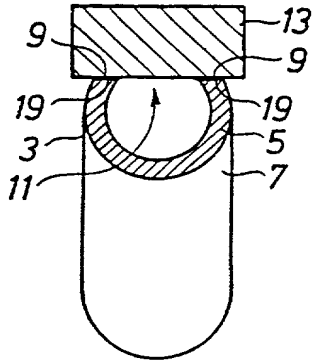

FIG. 2

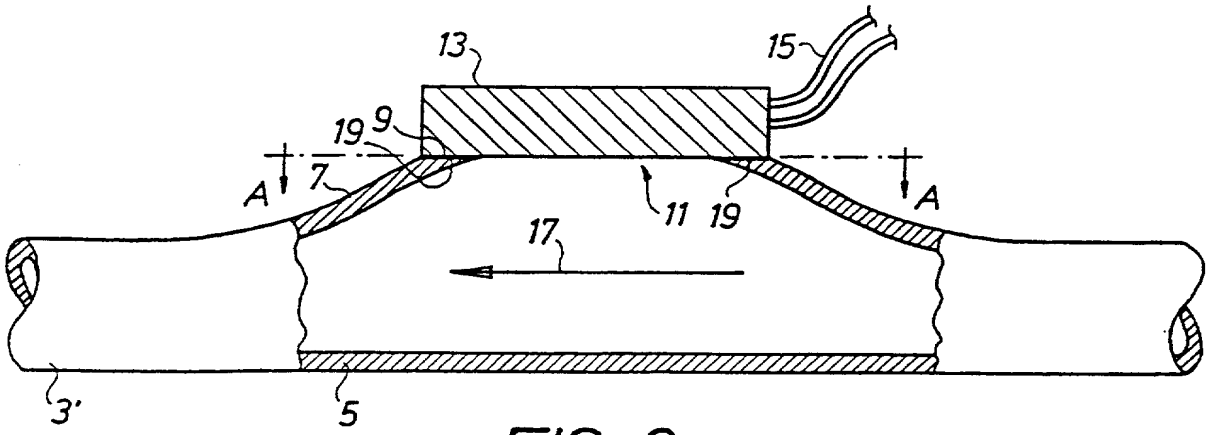

FIG. 3

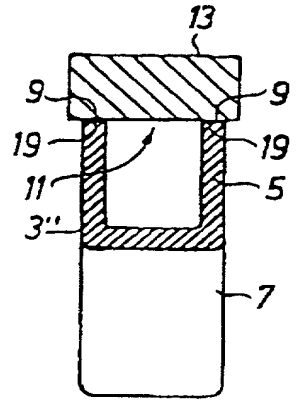

FIG. 4

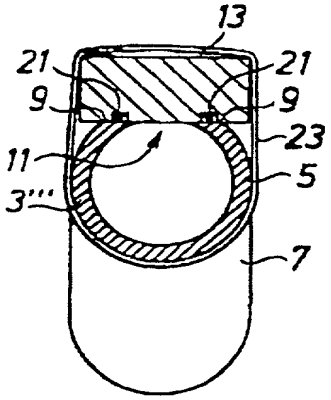

FIG. 5

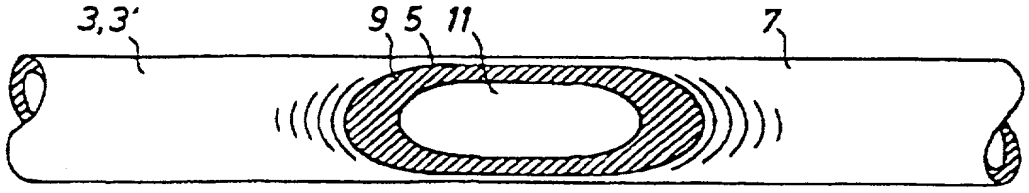

FIG. 6

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PTO/SB/01 (03-01)
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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

[ ] Declaration Submitted with Initial Filing **OR** [x] Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	GAMBRO-258
First Named Inventor	Johan Drott
COMPLETE IF KNOWN	
Application Number	09/980,066
Filing Date	
Group Art Unit	N/A
Examiner Name	Not Yet Assigned

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ARRANGEMENT FOR MEASURING A PROPERTY OF A FLUID PRESENT IN A TUBE

(Title of the Invention)

the specification of which

[ ] is attached hereto

OR

[x] was filed on (MM/DD/YYYY) 05/30/2000 as United States Application Number or PCT International Application No. PCT/SE00/01132 and was amended on (MM/DD/YYYY) [ ] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365 (a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
9901981-2	SE	05/31/1999	[ ]	[ ]	[x]
			[ ]	[ ]	[ ]
			[ ]	[ ]	[ ]
			[ ]	[ ]	[ ]

[ ] Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

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PTO/SB/01 (03-01)
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DECLARATION — Utility or Design Patent Application

POWER OF ATTORNEY As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith Customer Number 000530

Direct all correspondence to: [X] Customer Number or Bar Code Label 000530 OR [ ] Correspondence address below

Name

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City | State | ZIP

Country | Telephone | Fax

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR: [ ] A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]): Johan | Family Name or Surname: Drott

Inventor's Signature | Date: 011123

Residence: City: Lund | State | Country: Sweden | Citizenship: Sweden

Mailing Address: Spolegatan 14

City: Lund | State | ZIP: S-222 20 | Country: Sweden

NAME OF SECOND INVENTOR: [ ] A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]) | Family Name or Surname

Inventor's Signature | Date

Residence: City | State | Country | Citizenship

Mailing Address:

City | State | ZIP | Country

[ ] Additional inventors are being named on the _____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.